



# Parity Progression Ratio Dynamics, Determinants, and Policy Approaches: A Study in Isfahan in 2020

Mohsen Naderi Beni<sup>1</sup>, Mansour Sharifi<sup>2\*</sup>, Jafar Kord Zanganeh<sup>3</sup>

<sup>1</sup>Department of Social Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran

<sup>2</sup>Department of Social Sciences, College of Literature, Humanities and Social Sciences. Garmsar Branch, Islamic Azad university, Garmsar, Iran

<sup>3</sup>Department of Social Sciences, Payam Noor university, Tehran, Iran

## Abstract

**Background and aims:** The fertility trend in Isfahan, as in other parts of the country, has decreased significantly in recent years. This study aimed to investigate the parity progression ratio (PPR) and factors affecting fertility.

**Methods:** This is a cross-sectional study that was conducted using a researcher-made questionnaire. Moreover, the study method was a survey, and the sample size included 662 married women aged 15 to 49 years. The study also employed a multi-stage cluster sampling method.

**Results:** The results revealed that the cumulative fertility rate ((CFR=1.5) has decreased in Isfahan. There was also a significant relationship between the number of children with abortion ( $P=0.001$ ), education ( $P=0.000$ ), and employment of women ( $P=0.02$ ). The results of multivariate regression with the control of women's job type also indicated that the variables of the age of marriage and literacy of women ( $r=0.355$ ,  $P<0.05$ ) in householders, age of marriage ( $r=0.286$ ,  $P=0.00$ ) in unemployed, and literacy of women ( $r=0.336$ ,  $P=0.016$ ) in employed women have the highest explanation in childbearing.

**Conclusion:** To increase fertility and childbearing, more attention should be paid to economic issues, inflation reduction, and employment rise so that we can witness an increase in marriage, followed by childbearing to the level of succession. The best way to maintain the level of substitution is the full and comprehensive implementation of population policies and the implementation of adaptive policies appropriate to the level of fertility.

**Keywords:** Parity progression ratio, Fertility, Population policies, Total fertility, Parity, Birth order

\*Corresponding Author:  
Mansour Sharifi,  
Email: sharifim@ut.ac.ir

Received: January 21, 2023

Accepted: March 14, 2023

ePublished: May 2, 2023



## Introduction

Changes in fertility and population growth have been one of the most important population issues that have been the concern of rulers, politicians, and researchers since the distant past. From a historical point of view, fertility has been one of the important and influential topics in societies, so population growth was considered the most important factor in increasing economic and defense power. The increase in fertility and population from the perspective of religions has also received special attention. In general, most religions have been in favor of population growth and high fertility,<sup>1</sup> but there have been extensive changes in fertility behavior in most regions of the world in the last quarter of a century. However, more than half of the world's population is currently living in areas with fertility rates below the population replacement level (less than 2.1 children per woman).<sup>2,3</sup> Fertility has been one of the most important demographic issues in recent years in Iran. The population of Iran in 1956 and the first population census was around 19 million people. In the last census in 2016, about 80 million people were counted; therefore, the survey of Iran's population from the first census to the

last census shows that about 61 million people have been added to the country's population. In other words, in the last 60 years, the population of Iran has increased by 4.2 times. The maximum amount of population growth at this time is related to the period between 1976-1986 with a value of 3.91%, and the minimum value is related to the period between 2011-2016 with a value of 1.24%.<sup>4</sup> The population of the urban areas of the country in the first general population census was over 6 million people, and the rural population was about 13 million people (68%). Therefore, it can be seen that after 60 years, that is, in 2016, the population of each city has increased about 10 times (more than 59 million people), and the number of rural populations has increased about 1.6 times (more than 20.7 million people).<sup>3,4</sup>

Knowledge of the causes and factors affecting the reduction of childbearing can guide relevant officials in line with appropriate measures to prevent and guide people to increase childbearing. In recent years, the fertility trend in the urban areas of Iran has decreased sharply, and Isfahan has been reported to be one of the cities with a very high decrease in fertility.

The authors' calculations in this research showed that the total fertility rate (TFR) in this province was decreasing from 2017 to 2020. This amount was 1.9, 1.7, 1.5, and 1.35 in 2017, 2018, 2019, and 2020, respectively, but the marital fertility data indicated that the total marital fertility rate in 2020 was equal to 2.09 based on the authors' calculations. This amount is considered close to the replacement level, and it seems reasonable to worry about the decrease in overall fertility in this province, and we should expect a decrease in this amount in married people as well.

Many studies have been done on childbearing and the factors affecting it, and there are many theories about this. For example, in their study, Najafi et al investigated the factors affecting the spacing of children using the parity progression ratio (PPR) method. The analysis of their study revealed that the age of women's marriage and the employment of men and women are the most important factors in the birth of the first child. Mothers' education was also effective in the first to fourth place, but parents' education affected the distance between the second and third children. This research also displayed a significant reduction in third and fourth-rank children in an effective way.<sup>5</sup>

In his research on fertility in Iran, Nejatian analyzed the status of the announced policies on population with a programmatic approach. The findings of his research suggested that paying special attention to the topic of marriage, its facilitation, reducing divorce, and increasing the ratio of married couples, especially in the age group of 15-29 years, can exert the highest effect on the implementation of childbearing and population increase policies.<sup>6</sup>

Towriss found that education and literacy make a big difference in spacing between children by rural and urban women, and education has a considerable effect on the use of contraceptive methods.<sup>7</sup> The final results of this research showed that postponing the first birth with a decrease in the TFR, an increase in the childlessness rate, and an increase in the average age at the first birth are important factors for reducing the fertility rate, but the relationship between women's education and the level of women's education is weak in the fertility rate. In fact, the effect of education on childlessness and the fertility rate reduction was not found to be very strong.

The purpose of the current study was to investigate the relationship of some variables such as the age of marriage, income, social class, and literacy with fertility, childbearing, and the increase in the number of children. Moreover, fertility analysis based on PPR instead of using TFR is one of the goals of this study.

Most of the previous studies have been based on the TFR, but due to the more expressive expression of the possibility of women having children, the fertility trend in this study was based on the PPR.

## Materials and Methods

### Type of Study

This is a cross-sectional study carried out using a

researcher-made questionnaire.

### Study Population

The statistical population included married women aged 15-49 in Isfahan. According to the population data of Isfahan City Health Center, the number of people in the statistical population is 340 000. Before the implementation of the research, 50 questionnaires were distributed to determine the variance of the study, and the variance of the number of children variable was determined to be 1.027.

### Sample Size

By determining the error value of 8% and the confidence level of 95%, a sample size of 662 people was obtained. Further, Cochran's formula was used to determine the sample size in the survey.<sup>8,9</sup>

### Sampling Method and Data Gathering

The study used a multi-stage cluster sampling method. In this way, at first, different areas of Isfahan were determined, and then from each area, the sample size of the desired cluster was selected. Afterward, random sampling was done from each area based on the health records of each household, and in the next step, the mentioned questionnaires were sent electronically. It was given to the sampled people, and they were asked to complete the information in the relevant electronic form and through communication software such as Telegram, email, WhatsApp, and the like. First, the designed questionnaire was distributed and completed by 50 people eligible to enter the study, validity and reliability of the questionnaire were confirmed, and then the desired data were extracted and analyzed.

### Validity and Reliability of Tools

Face validity was used to determine the validity, and the questionnaire was confirmed by the relevant professors and experts. For this purpose, a wide range of specialists and lecturers of the university were consulted regarding the questionnaire: a social medicine specialist in the University of Medical Sciences, two professors in the field of Demography, and a professor in the field of Social Sciences and Sociology, all of whom were members of the faculty of universities of the Ministry of Science and Research Centers. Furthermore, four experts in the field of Deputy Health of the Provincial Health Center and the Research Center of Social Sciences affecting health were consulted. To determine reliability, according to the type of questions, methods such as retesting were used.

### Statistical Analysis Method

To analyze the data, at first, the PPR was calculated using a cross-sectional method, and in the next step, statistical tests and Stepwise method regression were used to analyze the relationships between the variables at two descriptive and inferential levels, respectively, using SPSS

software version 18. Statistical tests to find the effect of independent variables on the dependent variable included an independent t-test and ANOVA test. Durbin-Watson's test was also used for autocorrelation.

When women or parents think about childbearing, they usually think in terms of starting a family or increasing their family by adding another child. A PPR is the proportion of women who progress from one parity to the next. PPRs can be calculated for cohorts of women defined either by age or marriage. Generally, age cohorts of women are considered, that is, the PPRs are calculated from the parity distribution of a particular age group of women.

PPRs are useful to understand the distribution of cohort fertility (i.e., the proportion of women in a cohort who end up with exactly no children, exactly one, exactly two, and at the end of the childbearing years). It should be noted that the calculation of PPR can also be determined based on the sampled data, but the effect of timing is also effective.<sup>10,11</sup>

The effect of timing can cause fluctuations in the fertility analysis, so for the correct expression of this analysis and the absence of the effect of the timing of the sampled data, it is used only for the desired year and cannot be considered a time series obtained and analyzed similar to cohort data. PPRs measure the proportion of women with  $n$  children who go on to have  $n+1$  child.<sup>10-13</sup>

The method of calculating the PPR is as follows:

$$a_n = \frac{\text{Number of women who have a (n+1) child}}{\text{Number of women who have a (n) child}}$$

In calculating PPR, first, the number of married women is determined according to the number of live children born in each rank, then it is summed up cumulatively from the last rank to the first rank. Then, the cumulative number of the next rank of children is divided by the previous rank. The resulting number is the ratio of the number of women who have a certain number of children and give birth to the next child. For example,  $a_0$  is the proportion of women who have no children and are going to give birth to their first child. Then, the cumulative fertility rate (CFR) can be obtained from the following equation:

$$CFR = a_0 + a_0 a_1 + a_0 a_1 a_2 + \dots$$

## Results

As previously mentioned, the number of participants in this study was 662, which included married women aged 15 to 49 years. The highest frequency distribution and percentage were in women aged 35 to 39 years and then 30 to 34 years, respectively. The rate was 25.1 and 23.6, respectively, but in the very young age groups (i.e., 15-19 years old), this percentage is extremely low (2.1%), as depicted in Table 1.

The results of this study showed the distribution of

frequency and percentage of respondents according to the number of children. Table 2 depicts that mothers with two children and mothers with four children have the highest (40%) and the lowest (1.81%) number of children, respectively. Interestingly, the sum of two children and three children constituted more than 50% of the respondents (Table 2).

As explained in the method section and calculation of the PPR sequence section, one of the goals of this research is the calculation of the PPR; furthermore, CFR, which is an estimate of the TFR, was also calculated. Based on the distribution of the ratio of the sequence of live birth, the probability of having a child in those who are childless and give birth to their first child is 85%, suggesting that 85% of those who were childless will give birth to their first child. Likewise, 61% of those who had their first child give birth to their second child, 23% of those who had their second child give birth to their third child, and 15% of mothers who had three children give birth to their fourth child. The CFR is also 1.5 which is lower than the replacement level (2.1), as illustrated in Table 3.

The average difference test between the number of

**Table 1.** The Distribution of Frequency and Percentage of Respondents According to the Age Group of Women in 2020

Age Group	Frequency	Percent	Cumulative Percent
15-19	14	2.1	2.1
20-24	24	3.6	5.7
25-29	103	15.6	21.3
30-34	156	23.6	44.9
35-39	166	25.1	69.9
40-44	111	16.8	86.7
45-49	88	13.3	100
Total	662	100	

**Table 2.** Frequency Distribution and Percentage of Respondents According to the Number of Children in 2020

No of Children	Frequency	Percent	Cumulative Percent
0	102	15.41	15.41
1	216	32.63	48.04
2	265	40.03	88.07
3	67	10.12	98.19
4	12	1.81	100
Total	662	100	

**Table 3.** Distribution of PPR and Calculation of CFR in 2020

No of Children	No of Married Women	A Gathering from Below	An/An-1
0	102	662	0.85
1	216	560	0.61
2	265	344	0.23
3	67	79	0.15
4	12	12	0.00

Note. PPR: Parity progression ratio; CFR: Cumulative fertility rate; CFR = 1.5.

children and the grouped variables showed that the variables of abortion, women’s literacy, and women’s employment are significantly different from the independent variable ( $P \leq 0.05$ ), and the variable of children’s desire is not significantly different from the dependent variable ( $P > 0.05$ ), as observed in Table 4.

Table 5 analyzed the quantitative variables of women’s marriage age as well as spouse’s income, literacy, and social class using a multiple regression test along with the control of women’s job variable. In this regard, a multivariate regression and Durbin-Watson’s internal correlation method were used to check the effect of other variables on the dependent variable by controlling the job type variable. This table showed that in householders, the variables of women’s marriage age and literacy have a significant and inverse effect on having children ( $P \leq 0.05$ ), it also indicated multiple variables that entered the equation by keeping the job variable constant. As observed, in the first model, which was related to housewives, the value of width from the origin was 3.8, which means that without the influence

of other variables, there are four numbers of children in housewives. Moreover, according to the value coefficient b, the effect of the variables of women’s marriage age, education, and social class on childbearing reduced. In other words, in housewives, these three variables caused a decrease in the number of children, each of which has its effect coefficient, as seen in the Table 5. On the other hand, it was seen that the housewives’ income leads to an increase in the number of children according to the effect coefficient. However, as it is clear from the values in the table, the influence of independent variables is different in other models. In Model 2, based on the value of coefficient b, the effect of women’s marriage age, spouse’s income, and social class on childbearing reduced in unemployed women, and only education increased childbearing in unemployed women. Furthermore, the value of the width from the origin indicated three children in unemployed women, which means that without the influence of any of the independent variables, unemployed women give birth to three children, but with the influence of the other three variables, childbearing is reduced. In Model 3, it can be seen that working women can give birth to four children without the influence of any of the independent variables, but with the influence of women’s marriage age, education, and social class, this number decreased and reached lower values, and similarly, spouse’s income had a significant effect on working women’s fertility. In general, this table suggests that without the influence of any of the variables, childbearing in the studied married women is three children and above, but it should be noted that the childbearing of housewives and working women is about four children, while unemployed women had three children. After calculating the effect of the studied variables, it was found that the husband’s income and working women increase childbearing, and other variables have the opposite effect. Nevertheless, in unemployed women, education increases childbearing, while other variables such as the husband’s income have a decreasing effect.

**Table 4.** Difference Test of Average Number of Children According to Grouping Variables in 2020

Variable	Number	Mean	Statistical Test (t-test / ANOVA)	P Value
Abortion	Yes	165	3.507	$\leq 0.001$
	No	497		
Women’s literacy	Elementary	7	7.743	$\leq 0.001$
	Guidance school	23		
	Diploma	134		
	Bachelor’s degree	366		
Employment of women	Masters and Ph.D	132	3.922	0.020
	Householder	342		
	Unemployed	216		
Desire of children	Employed	104	-1.661	0.097
	Wanted	493		
	Unwanted	31		

**Table 5.** Variables Entered in the Multivariate Regression Equation by Controlling the Job Variable

Stage	Variable Names	Control Variable (Type of Job)	B	Coefficient b	Beta	P-value
Model 1	Marriage age of women	Householder	3.876	-0.61	-0.266	$\leq 0.001$
	Spouse’s income			0.020	0.087	0.103
	Literacy			-0.149	-0.131	0.018
	Social class			-0.179	-0.095	0.081
Model 2	Marriage age of women	Unemployed	3.059	-0.059	-0.284	$\leq 0.001$
	Spouse’s income			-0.009	-0.065	0.338
	Literacy			0.030	0.017	0.803
	Social class			-0.110	-0.051	0.453
Model 3	Marriage age of women	Employed	4.125	-0.042	-0.178	0.080
	Spouse’s income			0.008	0.042	0.686
	Literacy			-0.324	-0.261	0.016
	Social class			-0.148	-0.068	0.508

## Discussion

The findings of this study showed that the fertility rate in Isfahan is decreasing, although the total marital fertility rate was 2.09 in 2020, and 85% of childless mothers gave birth to their first child. Although a percentage of the remaining amount was due to infertility, the percentage of mothers who wanted their first child was significant. Moreover, 61% of mothers with one child and 23% of mothers with two children tended to have a higher-ranked child and give birth to the next-ranked child, and 15% of mothers who had three children gave birth to their fourth child. As mentioned before, in many demographic theories, having children has been discussed from an economic and cost point of view. The significant decrease in the number of children born in ranks higher than the third can be explained by Becker's theory, which associates more income to improving the quality of children. This decrease can also be justified with the theory of Arsene Dumont who believes that the decrease in the number of children can create social capital and promote individual well-being and development.<sup>14</sup> The findings of the PPR in women who have almost completed their fertility showed that these women are in the right place to have children. For example, 85% of childless women aged 15 to 49 gave birth to their first child, and 61% of women in this age group who have one child gave birth to their second child, and 23% who had two children were looking for a third child. This rate indicates a decrease in the fertility rate, but the data in [Table 3](#) revealed that this decrease is evident in the ranks of the third and fourth children. In terms of TFR, Isfahan is one of the provinces with a very high decrease in fertility. According to the authors, the increase in development indicators has been one of the most important factors in reducing fertility. Therefore, childbearing strategies need to be implemented more and more precisely. In this regard, the theories of demographic changes and responses, the theory of rational behavior, and the theory of modernization explain that an increase in the level of development leads to a decrease in fertility. Punitive policies do not have the necessary accountability in any way. Factors such as collecting preventive equipment from health centers and health homes will not yield any results except dissatisfaction, and finding other ways to use these methods, on the other hand, will lead to unwanted pregnancies and an increase in illegal abortions. Childbearing policies should be strengthened at the macro level, and the main roots of childbearing decline (e.g., economic and cultural problems) and proper foresight should be solved. According to the policies communicated by the leadership in 2014, it is necessary to eliminate the obstacles and problems related to employment, housing, and economy to facilitate the marriage of young people, and subsequently, to strengthen childbearing. Haerimehrizi et al demonstrated that solving economic problems is effective in having children. Currently, there is more pressure on married people to have children, and creating restrictions has put pressure on married people,

but proper and correct planning and action has not been made on single people. For example, the amount of employment, which is one of the most important factors affecting marriage, has not decreased, or there is no proper management in the field of abortion.<sup>14</sup> Therefore, it is necessary to strengthen adaptive policies, and the government should make efforts in this direction. The findings also indicated that there is a desire to have two children and sometimes even three children, while the desire to have three children and above has decreased drastically, and this can be a factor in reducing the fertility rate. In fact, the decrease in TFR is seen in children with third and higher ranks.<sup>15</sup> In addition, the findings suggested that more than 50% of the studied people have two or three children. In fact, it can be stated that parents want up to two children, but the desire to have more children has drastically decreased. This finding is consistent with the findings of Najafi et al in 2017 who reported the reduction of fertility in the third, fourth, and higher number of children. Moreover, the findings showed that people's age and marriage age have a considerable effect on the number of children in the family. In Najafi et al's research, the role of marriage age in having children was also reported.<sup>5</sup> The same finding was also observed in studies conducted by Roustaei et al and Towriss.<sup>7,16</sup> Furthermore, the area of residence and the type of residence are effective in the number of children. If we consider this factor as one of the comfort factors, then this factor is also consistent with other studies such as Rastegar Khaled & Moghadami and Margolis's study who emphasized comfort facilities.<sup>17-19</sup> The effect of factors such as education, literacy, and history of abortion is also significant in determining the number of children. According to McDonald's theories, gender equality was effective in reducing the number of births. One of the examples of gender equality has been women's education, which is consistent with MacDonald's theory.<sup>20</sup> As mentioned earlier, the role of education in reducing childbearing can be seen in Towriss and Roustaei and colleagues' studies.<sup>7,16</sup> The findings of the multivariate analysis showed that childbearing differs without the influence of independent variables and depending on the type of women's job and that working women have approximately one less child compared to housewives. The independent variables such as women's marriage age, literacy, in the childbearing of housewives, and employed women caused a decrease in childbearing, but in unemployed women, the independent variable of literacy lead to a decrease in childbearing. Further, women's marriage age is a variable contributing to the decrease in childbearing in unemployed women.

## Conclusion

The findings of this study suggested that the age of having children has increased slightly compared to previous years and has increased from 20-30 years to 30-40 years, which indicates a delay in having children. Furthermore, this study showed that the highest rate of having children is in

the second children, so the number of children is in a good state, but the increase in the number of children is higher, and this has caused a decrease in the TFR. This denotes the differences; moreover, the age of women's marriage is one of the variables that could have a significant impact on having children. The development in marriage policies, policies that put the ease of marriage on the agenda, and suitable adaptive and encouraging policies as well as avoiding punitive policies can ultimately increase childbearing. Therefore, creating a suitable platform for fertility and having children such as economic stability, increasing the level of welfare and development, increasing employment and reducing unemployment, rising the level of income, and facilitating access to suitable housing can imply an increase in having children.

#### Competing Interests

The authors declared no conflict of interests.

#### Ethical Approval

This study was a survey, and there was no intervention in the research participants. Therefore, human or animal samples were not used in this study.

#### References

1. Ketabi A. An Introduction to the Leads and Theories of Demography. Tehran, Iran: SAMT Publications; 2008. p. 5. [Persian].
2. Bongaarts J, Feeney G. On the quantum and tempo of fertility. *Popul Dev Rev.* 1998;24(2):271-91. doi: [10.2307/2807974](https://doi.org/10.2307/2807974).
3. Fathi E, Javid NM, Hosseini SM, Mirzaei S, Nasiri poor M, Mahzoon AA. The past trend, the current and prospective situation of Iran's population up to the horizon of 2046. *Development and Foresight Research Center.* 2019;61:21. [Persian]
4. Abbasi-Shavazi MJ, McDonald P, Hosseini-Chavoshi M. The Fertility Transition in Iran. Vol 75. Springer; 2009.
5. Najafi-Vosough R, Soltanian AR, Fayyazi N. Influence factors on birth spacing and childbearing rates using survival recurrent events model and parity progression ratios. *J Res Health Sci.* 2017;17(3):e00384.
6. Nejatian MH. An introduction to a planning approach. *J Plan Dev.* 2020;5:119-44. [Persian].
7. Towriss CA. Birth Intervals and Reproductive Intentions in Eastern Africa: Insights from Urban Fertility Transitions [dissertation]. London School of Hygiene & Tropical Medicine; 2014.
8. Rafipoor F. Excavations and assumptions- an introduction to social studies and social research. Tehran, Iran: Enteshar publication; 2004. p.369-389.
9. Saraei H. An introduction to sampling in research. Tehran. Iran. 2014.9. [Persian].
10. Hinde A. *Demographic Methods.* London: Arnold; 1998.
11. Spoorenberg T. Evaluation and analysis of fertility data. In: *Regional Workshop on the Production of Population Estimates and Demographic Indicators.* Addis Ababa: United Nations Department of Economic and Social Affairs; 2015. p. 18-21.
12. Siegel JS, Swanson DA. *The Methods and Materials of Demography.* 2nd ed. Elsevier; 2004. p. 769.
13. Moultrie TA, Dorrington RE, Hill AG, Hill K, Timæus IM, Zaba B. *Tools for Demographic Estimation.* International Union for the Scientific Study of Population; 2013.
14. Mason KO. Explaining fertility transitions. *Demography.* 1997;34(4):443-54.
15. Seyed Mirzaei SM. *General Demography.* Tehran, Iran: University of Shahid Beheshti Publication; 2002. p. 41-3. [Persian].
16. Roustaei Z, Räisänen S, Gissler M, Heinonen S. Fertility rates and the postponement of first births: a descriptive study with Finnish population data. *BMJ Open.* 2019;9(1):e026336. doi: [10.1136/bmjopen-2018-026336](https://doi.org/10.1136/bmjopen-2018-026336).
17. Haerimehrizi AA, Tavousi M, Sadighi J, Motlagh ME, Eslami M, Naghizadeh F, et al. Reasons for fertility desire and disinterest among Iranian married adults: a population-based study. *Payesh.* 2017;16(5):637-45. [Persian].
18. Rastegar Khaled A, Moghadami S. Investigating the relationship between desire and traditional values and attitude towards children. *Sociology of Social Institutions Review.* 2018;97(11):153-74. [Persian].
19. Margolis R, Myrskylä M. Parental well-being surrounding first birth as a determinant of further parity progression. *Demography.* 2015;52(4):1147-66. doi: [10.1007/s13524-015-0413-2](https://doi.org/10.1007/s13524-015-0413-2).
20. McDonald P. Convergence or compromise in historical family change?. In: *Family Systems and Cultural Change.* Oxford: Clarendon Press; 1992. p. 15-30.